

**CLAIMS**

1. A composite structure, the structure comprising a dual-function material intermediate a conducting material and a semiconductor; wherein the  
5 conducting material comprises an ohmic conductor, a semiconducting material or an ionic conductor and wherein the dual-function material comprises an organic material and at least one ionic species; said organic material comprising at least one moiety represented by the general formula (I):



wherein [Y] comprises an organic semiconductor; and wherein X comprises an ion-chelating group, said organic material having both electronic charge  
15 transport properties and supporting or chelating the at least one ionic species

2. A structure according to claim 1, wherein [Y] comprises a moiety represented by the general formula (II):



- 25 wherein Ar<sup>1</sup>, Ar<sup>2</sup> and Ar<sup>3</sup> are independently substituted or unsubstituted aromatic or hetero-aromatic rings or fused or otherwise conjugated derivatives thereof.

3. A structure according to claim 1, wherein [Y] comprises poly(1,4-phenylene), polypyrrole, poly(p-phenylenevinylene) (PPV), poly(thiophene), MEH-PPV, polyaniline or PEDOT

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4. A structure according to any of claims 1 to 3, wherein X comprises at least one group selected from:  $[-(\text{CH}_2\text{CH}_2\text{O})_n\text{CH}_2\text{CH}_2\text{OCH}_3]$ ,  $[-(\text{OCH}_2\text{CH}_2)_n\text{OCH}_3]$ ,  $[-\text{CH}_2\text{CH}(\text{R})\text{O})_n\text{CH}_2\text{CH}_2\text{OCH}_3]$  and  $[-(\text{OCH}(\text{R})\text{CH}_2)_n\text{OCH}_3]$ ; wherein n is an integer, preferably 2 to 10, more preferably 2 to 4; wherein R is straight or branched alkyl chain of 1 to 10 carbon atoms, preferably of 1 or 2 carbon atoms.

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5. A structure according to any of claims 1 to 3, wherein X comprises a crown ether, a podand, a lariat ether, a cryptand or a spherand.

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6. A structure according to any preceding claim, wherein the at least one ionic species is chosen from:  $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cs}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ , triflimide, halide, perchlorate, trilate and BARF salts of the above cations.

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7. A structure according to any preceding claim, wherein the conducting material comprises an ohmic conductor and is chosen from: a metal, graphite, a highly-doped semiconductor and an organic conductor.

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8. A structure according to any of claims 1 to 6, wherein the conducting material comprises a semiconducting material and is chosen from:  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{SnO}$ ,  $\text{Ta}_2\text{O}_5$ ,  $\text{Nb}_2\text{O}_5$ ,  $\text{WO}_3$ , OMeTAD, PPV, Cu-phthalocyanin, polythiophenes, polypyrroles, pentacene and perylenes..

9. A structure according to any of claims 1 to 6, wherein the conducting material comprises an ionic conductor and is chosen from: a polymer electrolyte, a polymer supporting a redox active species.
- 5 10. A structure according to any preceding claim, wherein the semiconductor is chosen from  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{SnO}$ ,  $\text{Ta}_2\text{O}_5$ ,  $\text{Nb}_2\text{O}_5$ ,  $\text{WO}_3$ , OMeTAD, PPV, Cu-phthalocyanin, oligo- or polythiophenes, polypyrroles, TPDs, pentacene and perylenes.
- 10 11. A structure according to any preceding claim, wherein the semiconductor is porous and the dual-function material is at least partially contained within the pores of the semiconductor.
- 15 12. An electrochemical device, the device comprising a structure according to any preceding claim and one further, or two ohmic conductors such that the device is provided with two external ohmic conductors.
- 20 13. A photo-voltaic cell, the cell comprising a structure according to any of claims 1 to 11.
14. A device according to claim 12 which is a photodiode, a battery, an electrode, an electrochromic device or a light-emitting diode.